Name.....Group.....

Department of Communication
& Electronic Engineering.

Module: TECH010

Semester 2

Mini Organ Project

GENERAL NOTES ON CONSTRUCTION.

Trim the printed circuit board (pcb) to the outside edge of the rectangular boarder, using the guillotine and smooth the cut edges with a file.

Drill the pcb using the pcb drilling machines, ensuring that the pcb is firmly held whilst drilling (to prevent the drill bit from breaking). **Goggles must be worn.** Refer to the pcb drilling overlay sheet Page 6:12.

All holes are 0.8 mm unless listed below: -

these components require a 1.0 mm hole,	test pins, TP and P types, Stylus
and these a 1,3 mm hole	SW1 Pre-set potentiometers

N.B. the speaker mounting hole will be pre cut for you as well as the lead tensioning holes.

Ensure that all the holes are drilled, and the pcb is trimmed before fitting any components.

Fitting components.

Before fitting any components make sure that you can identify the type, value and polarity.

Start by fitting the wire link and fixed resistors (R1 - R25), carefully bend the component leads using pliers as shown in (*fig. 1*).

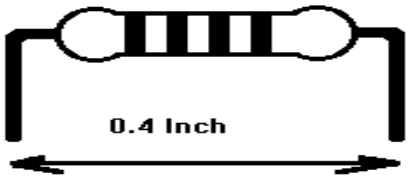

fig.1.

Insert the components in their respective positions into the pcb and gently bend and cut the leads as shown in (*fig. 2*).

fig. 2.

When you have inserted all the links and fixed resistors, **check their values**, and solder them into place.
Next fit the diode in the same manner (*caution* should be used when *bending the leads*

as it is a glass bodied device, also it is a *polarised device* and *must* therefore be *correctly orientated*) see *fig.3.*

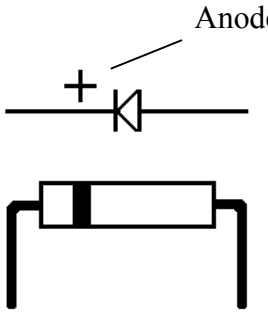

fig. 3.

Now fit the pins from the component side of the pcb, using a moderate amount of force with pliers, (*fig. 4*). Solder them carefully into place (*CAUTION* the pins will remain hot for about 1 minute after soldering).

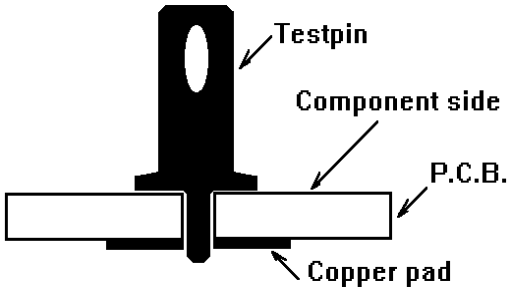

fig.4.

Variable resistors RV1 - 16 may be fitted next, they should be a reasonably snug fit into the pcb, but if they are loose then gently bend the tags to prevent them from falling out whilst soldering.

All non-polarised capacitors (C1 - C5) should now be fitted, leads bent trimmed and soldered.
Now fit capacitor C6, it is polarised, but note that on the component overlay the positive terminal position is marked, whereas the capacitor has it's negative terminal marked, see (fig.5).

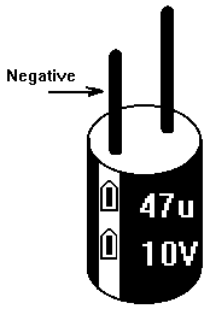

fig.5.

TR1 & 2 should not slip out of the pcb after insertion, but if they do bend the leads slightly to prevent this, solder in place, and snip off any excess lead (*fig.6*).

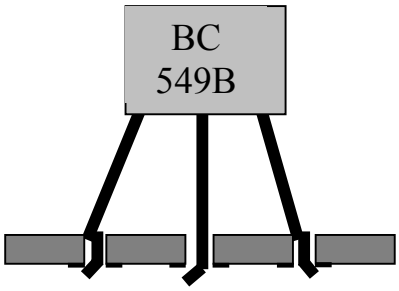

fig.6.

Insert dil SKT1 (dual-in-line socket), the socket for IC1. Note the orientation of the notch; refer to the component overlay for the correct position. Bend two opposing corner pins over, and solder as shown in *fig.7.*

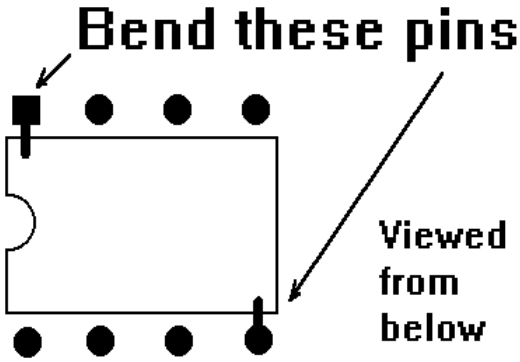

fig.7.

Fit the slide switch from the component side of the P.C.B. ensuring that it is correctly seated and that all of the pins are located and solder into place. Note: - the four fixing pins will require a fair amount of heat, but try to solder these as quickly as possible, as with the test pins the body of the switch will remain hot for over 1 minute.

Now take the battery snap and strip and tin both the red and black wires for approx. 10mm (if not already done) as in *fig.8.*

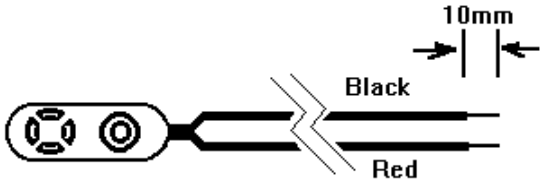

fig.8.

From the component side of the pcb, pass both the red and black wires through one of the 4mm holes to the solder side of the pcb. Return them both through the other 4mm hole to the component side of the pcb and solder the black wire to the pad marked 0V and the red wire to the pad marked +9V.

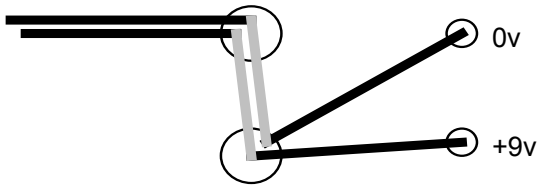

fig.9.

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Take the stylus and remove 10mm of insulation and tin the end (proceed with care as the insulation of this wire is very tough, and it contains many fine strands which may be easily broken). Pass the wire from the solder side of the pcb, through one of the 4mm holes (*fig.10a*) and return it to the solder side via another hole (*fig.10b*) and then via the hole adjacent to the stylus pin. Solder it to the stylus terminal (*fig.10c*). This again alleviates the need for a cable tie.

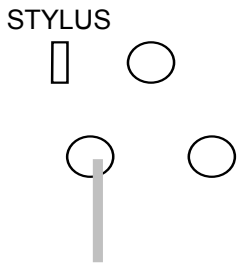

fig.10a.

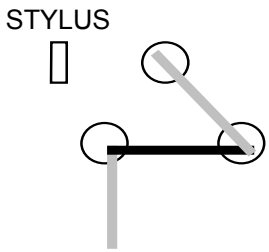

fig.10b.

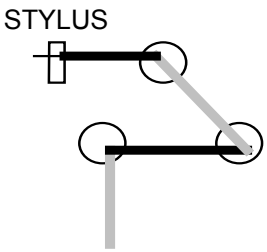

fig.10c.

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TESTING.

Do not use the battery, use the power supply unit and the Digital Multimeter (DMM) set to dc 20 mA range connected to the pcb in series with the PSU. Solder the test resistor, 68Ω, in place of the loudspeaker.

Connect the oscilloscope and the digital frequency meter (DFM) as shown in *fig.11* i.e. to TP1 and TP3, which is the ground pin.

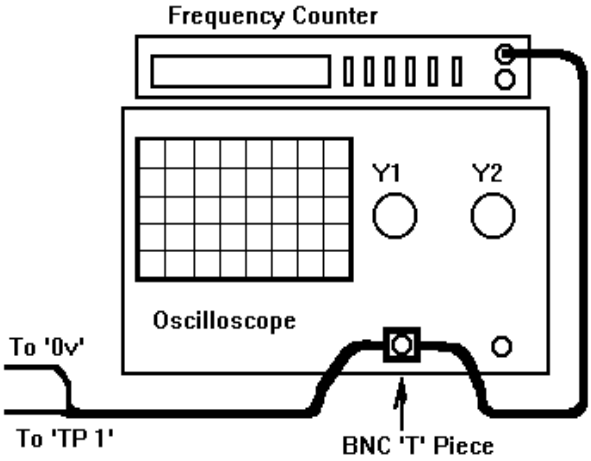


fig.11.

Set the oscilloscope 'Y1' channel to 2V / DIV and the timebase to 20mS / DIV.
Switch ON the TREMOLO supply, second position, and monitor the DMM, the reading should not exceed 10mA; if however, the value is higher switch OFF immediately and look for solder splashes.

Observe the oscilloscope display; this is the tremolo waveform, it should be nearly sinusoidal (*fig.12*). Its peak to peak amplitude should be approx. 8 volts and have a frequency of 5 - 10Hz. Use the oscilloscope to find the frequency by measuring the period of the waveform and finding the reciprocal.

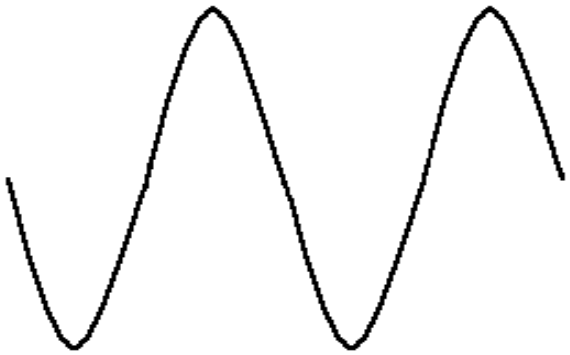


fig.12.

Switch the dc supply OFF and move the 'scope probe to the position shown in *fig.13* i.e. to pin TP4 and TP3, which is the ground.
Set the 'scope time base to 0.1uS, and set VR1 to it's mid-point.

Switch ON the dc supply and monitor the DMM, the reading should not exceed 5mA; if however, the value is higher switch OFF and investigate. **Connect stylus to link wire**, i.e. eliminating the individual NOTE potentiometers.

Observe the oscilloscope display with the timebase set to 50µs/DIV; this is the note waveform. It should be nearly square in shape (*fig.14*), have a peak to peak amplitude of approx. 8 volts.

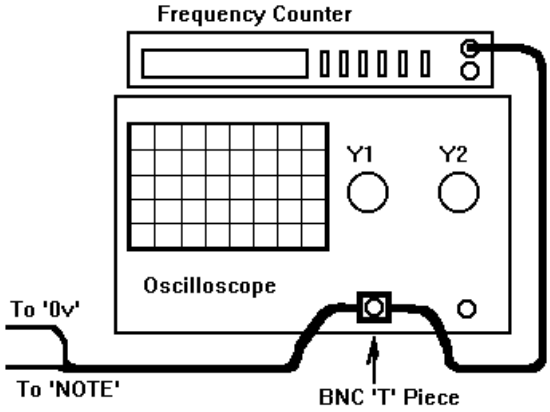


fig.13.

It is now time to perform the first of the adjustments necessary to align the note oscillator. Observe the 'scope and slowly adjust RV1, it should be clear that the width of the waveform, and hence it's frequency can be altered.

Adjust RV1 to give a frequency of 6.0kHz i.e. the period will be 3.34 at the setting of 50µs/DIV. (it will take some time for the DFM reading to become valid and accurate, as is has a long sample time).

When you have made this adjustment switch ON the TREMOLO and observe the effect on the note waveform, you should notice the frequency of the square wave alter in sympathy with the tremolo oscillator. Switch OFF supply and disconnect the oscilloscope.

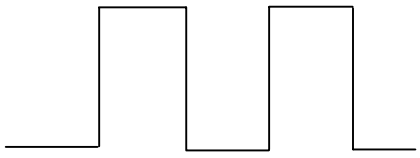


fig.14.

TUNING.

Connect the DFM as shown (*fig.15*.).

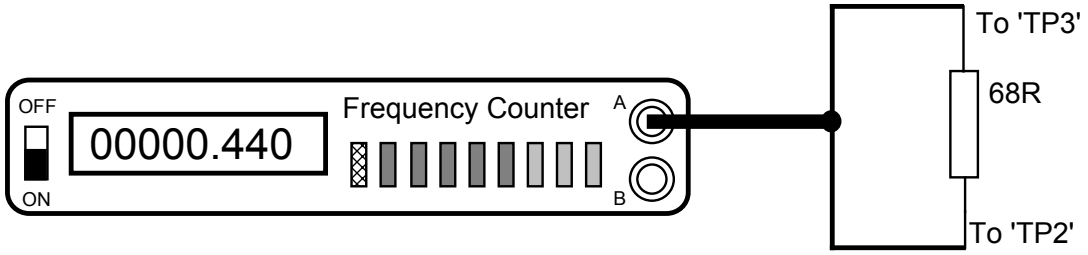


fig.15.

Set multimeter to read frequency and connect to P1 and TP3, which is ground. Hold stylus to P1 and adjust RV2 until a reading of 440 Hz is obtained. Then tune each note in turn referring to the following table: -

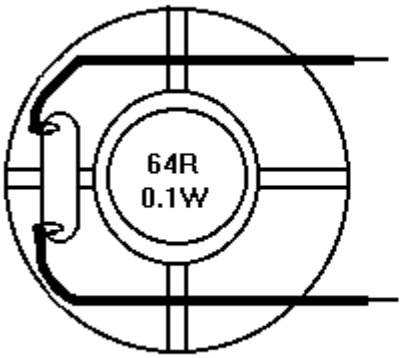
NOTE	Variable resistor N^{o}.	Frequency.
A	RV2	440.0 Hz
B flat	RV3	466.2 Hz
B	RV4	493.9 Hz
C	RV5	523.3 Hz
C sharp	RV6	554.4 Hz
D	RV7	587.4 Hz
E flat	RV8	622.3 Hz
E	RV9	659.3 Hz
F	RV10	698.4 Hz
F sharp	RV11	740.0 Hz
G	RV12	784.0 Hz
G sharp	RV13	830.7 Hz
A	RV14	880.0 Hz
B flat	RV15	932.4 Hz
B	RV16	987.8 Hz

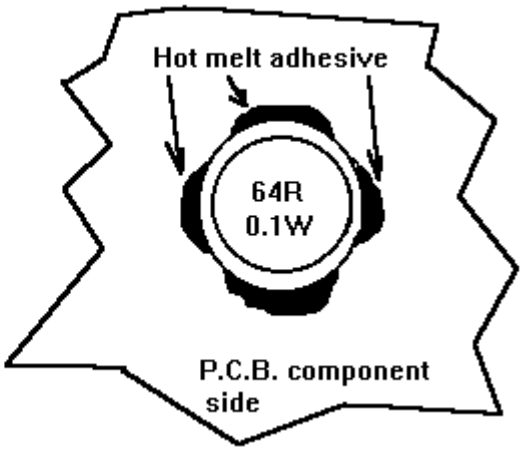
When all the adjustments have been made, switch OFF and disconnect the battery and test leads.

FINALLY.

Take two short lengths (40mm) of insulated wire and remove 5mm of insulation from all ends, and tin. Solder one end of each wire to each of the loudspeaker tags, and solder the other ends to the appropriate copper pads on the motherboard, trim ends.

Secure the loudspeaker to the motherboard using hot melt glue as below.



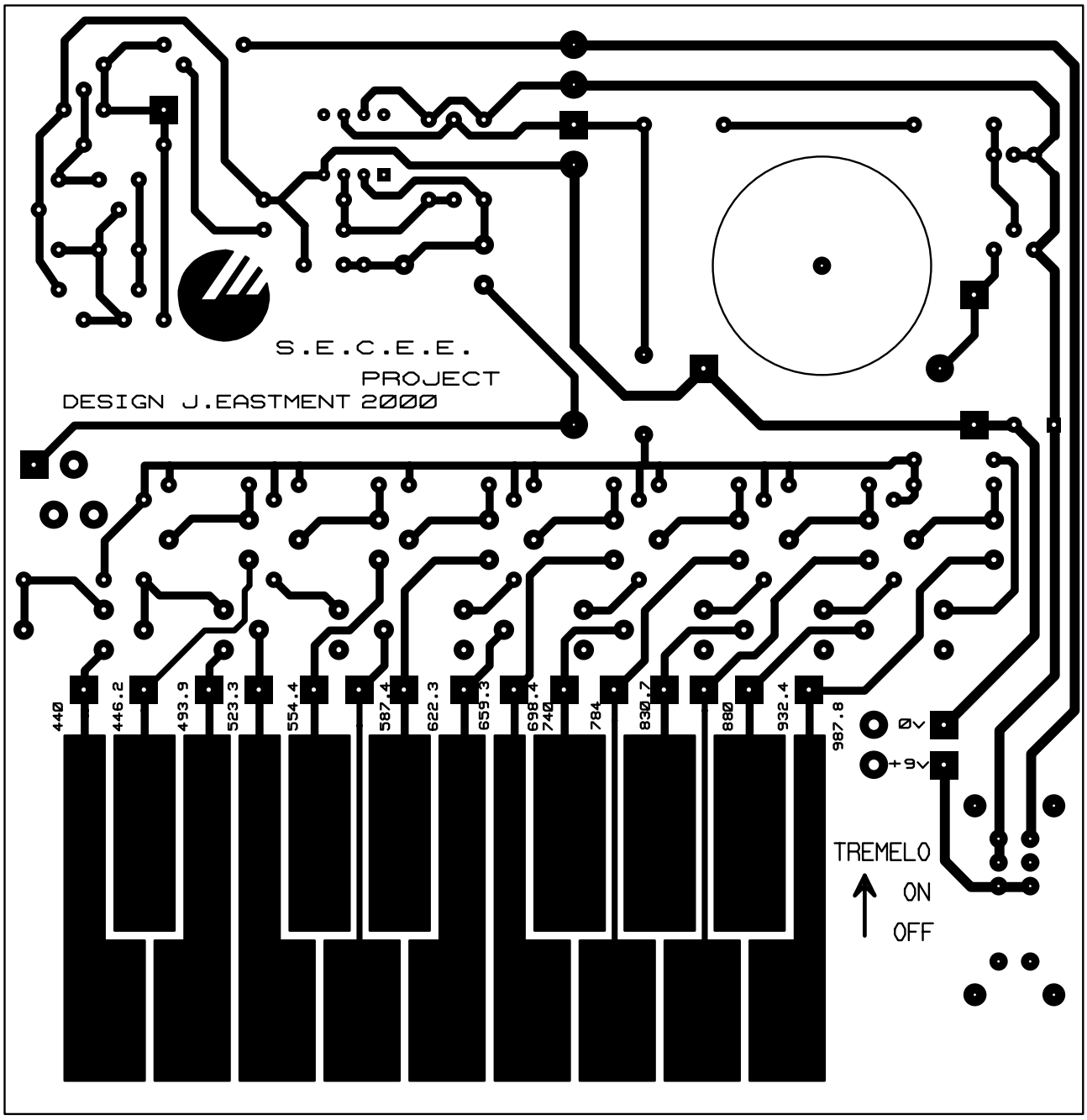


Attach the two adhesive pads used to secure the battery to the pcb. Connect the battery, but do not stick it to the pcb, switch ON and PLAY.

The overall pitch of the organ may be altered, if desired, by a small adjustment of RV1

Mini Organ Parts List.

Circuit ref.	Description	Value	Rating	
R1	RESISTOR	47k		¼W
R2	RESISTOR	47k		¼W
R3	RESISTOR	1M2		¼W
R4	RESISTOR	6k8		¼W
R5	RESISTOR	470k		¼W
R6	RESISTOR	39k		¼W
R7	RESISTOR	39k		¼W
R8	RESISTOR	1M		¼W
R9	RESISTOR	120k		¼W
R10	RESISTOR	33k		¼W
R11	RESISTOR	33k		¼W
R12	RESISTOR	30k		¼W
R13	RESISTOR	27k		¼W
R14	RESISTOR	27k		¼W
R15	RESISTOR	24k		¼W
R16	RESISTOR	22k		¼W
R17	RESISTOR	22k		¼W
R18	RESISTOR	20k		¼W
R19	RESISTOR	18k		¼W
R20	RESISTOR	15k		¼W
R21	RESISTOR	15k		¼W
R22	RESISTOR	15k		¼W
R23	RESISTOR	13k		¼W
R24	RESISTOR	13k		¼W
R25	RESISTOR	15k		¼W
TEST RESISTOR	RESISTOR	68R		¼W
RV1	Variable Resistor	4k7		
RV2 – 16	Variable Resistor	10k		
C1	CAP MYLAR	220n	10%	100V
C2	CAP MYLAR	220n	10%	100V
C3	CAP MYLAR	220n	10%	100V
C4	CAP MYLAR	100n	10%	100V
C5	CAP MYLAR	4n7	10%	100V
C6	CAP ELECTROLYTIC		47u	16V
D1	DIODE SIGNAL		1N4148	
D2	DIODE SIGNAL		1N4148	
TR1	TRANSISTOR NPN	BC547B		
TR2	TRANSISTOR NPN	BC547B		
IC1	OP-AMP		TL081	
LS1	LOUDSPEAKER		64R 66mm diameter	
SW1	SLIDE SWITCH		2P3W	
SKT1	8 PIN DIL SOCKET			
P1-16	TEST PINS			
T1-4+STYLUS	TEST PINS			


S.E.C.E.E.
PROJECT
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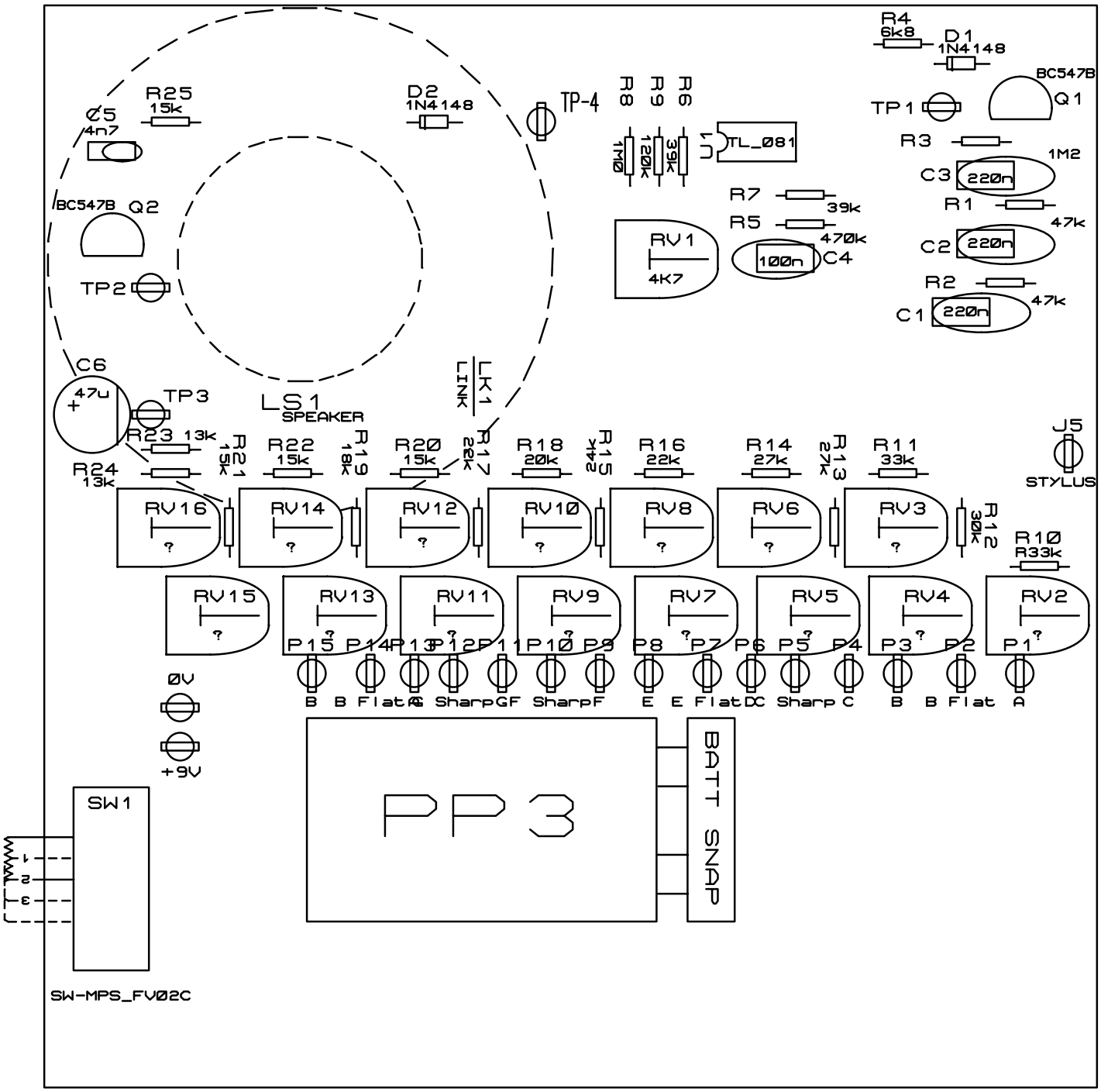
493.9
523.3
554.4
587.4
622.3
659.3
698.4
740
784
830.7
880
932.4
987.8
0v
+9v
TREMELO
ON
OFF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D1
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BC547B
Q1
TP1
R25
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C5
4n7
D2
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TP-4
R8
1M0
R9
120k
R6
39k
U1
TL_081
R3
1M2
C3
220n
R7
39k
R5
470k
C4
100n
RV1
4K7
R1
47k
C2
220n
BC547B Q2
TP2
R2
47k
C1
220n
C6
47u
TP3
LS1
SPEAKER
LK1
LINK
R23 13k
R24
13k
R21
15k
R22
15k
R19
18k
R20
15k
R17
22k
R18
20k
R15
24k
R16
22k
R14
27k
R13
27k
R11
33k
J5
STYLUS
RV16
RV14
RV12
RV10
RV8
RV6
RV3
R12
30k
R10
R33k
RV15
RV13
RV11
RV9
RV7
RV5
RV4
RV2
P15 P14 P13 P12 P11 P10 P9 P8 P7 P6 P5 P4 P3 P2 P1
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+9V
PP3
BATT SNAP
SW1
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2
3
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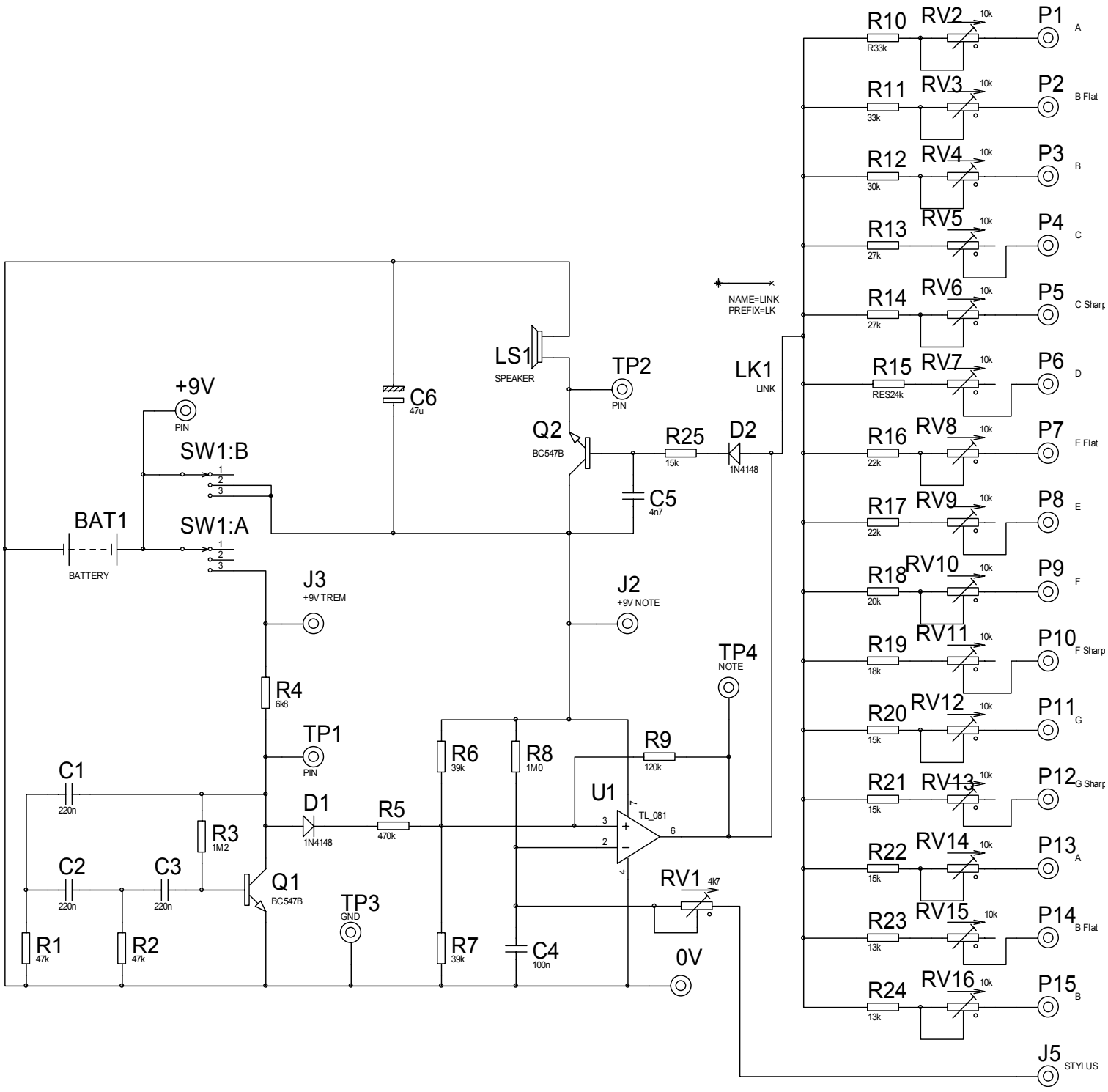
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SW1:A
BAT1
BATTERY
C6
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TP2
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D2
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C5
4n7
LK1
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PREFIX=LK
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+9V TREM
J2
+9V NOTE
TP4
NOTE
R4
6k8
TP1
PIN
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R3
1M2
D1
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R5
470k
R6
39k
R8
1M0
R9
120k
U1
TL_081
C2
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C3
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RV1
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47k
R2
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C4
100n
0V
R10
R33k
RV2
10k
P1
A
R11
33k
RV3
10k
P2
B Flat
R12
30k
RV4
10k
P3
B
R13
27k
RV5
10k
P4
C
R14
27k
RV6
10k
P5
C Sharp
R15
RES24k
RV7
10k
P6
D
R16
22k
RV8
10k
P7
E Flat
R17
22k
RV9
10k
P8
E
R18
20k
RV10
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P9
F
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STYLUS